FORAGING DISTANCE OF *POGONOMYRMEX OCCIDENTALIS* (HYMENOPTERA: FORMICIDAE) ON GRAZED AND UNGRAZED SHORTGRASS PRAIRIES IN COLORADO[1]

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ABSTRACT: Western harvester ants (*Pogonomyrmex occidentalis*) are granivores that preferentially collect certain seeds. In the ants' search for these preferred seeds, their foraging distances can be lengthy. However, the effects of grazing on *P. occidentalis* foraging distances have not been sufficiently studied. To test whether the ants foraged farther in grazed than in ungrazed sites, I offered commercial seeds (wheat and millet) at varying distances from the nests (6, 10, 12, 15, and 18m). Western harvester ants foraged significantly greater distances in grazed sites than in ungrazed sites. I conclude that the ants forage farther to collect their preferred seeds in grazed ecosystems because there is more bare ground, a consequence of grazing.

Pogonomyrmex species foragers often travel long distances to collect preferred seeds (Rogers 1974, Whitford 1978, DeVita 1979, Anderson 1988, Holldobler & Wilson 1992). DeVita (1979) found that the foraging activity of *P. californicus* in the Mojave desert was highest near the nest, but that individual ants foraged up to 13 m away from their nests. Rogers (1974) studied foraging in northeastern Colorado in lightly grazed and heavily grazed grasslands; maximum foraging distances were 11.0 m and 14.3 m, respectively. Rogers' differences were not significant, but the data support DeVita's findings in terms of the maximum foraging distance for the ants. Other studies have verified these foraging distances for *Pogonomyrmex* species and other granivorous ants (Whitford 1976, Anderson 1988). Fewell (1988) showed that on sparsely vegetated sites, such as grazed sites, western harvester ants walked significantly faster and traveled significantly farther. In this study I tested the hypothesis that western harvester ants forage farther in grazed sites than in the ungrazed sites.

MATERIALS AND METHODS

In order to determine the maximum foraging distance of the ants and to establish whether this distance varied between the grazed and ungrazed sites, I offered millet and crushed wheat seeds to the ants in petri dishes. These seeds were offered at varying distances away from the nests on two study sites, one grazed and one ungrazed. Millet and crushed wheat seeds were of-

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fered because preliminary experiments showed that the ants readily collected these seeds. However, the use of crop seeds did not lead to an overestimation of foraging distances because I followed the ants' trunk trails as they foraged up to and beyond the tested distances prior to the availability of crop seeds.

Both grazed and ungrazed sites were located in Boulder County, CO. One site was located in Louisville on Rock Creek, which is owned by Boulder County Open Space. The second site was located on Horse Creek Ranch, just north of the City of Boulder.

At each site, a minimum of three nests were tested but whenever possible more nests were used. Therefore, a minimum of 15 nests were tested during these times. These nests were well established and were approximately the same size and age.

I placed the seeds in petri dishes and set them in or near an active trunk trail. The active trunk trails were randomly chosen. The seeds were placed near the trunk trails to ensure that the ants would find the dishes and forage from them. Only one trial per day was run to avoid "forager memory" of the dish placement. In addition, trials were done on alternating days.

Beginning 23 June, 1994, crop seeds in shallow petri dishes were placed at 6, 10, 12, 15, and 18m from the nest entrance. The test ended at 18m because previous studies showed that the ants foraged primarily up to 14m. In addition, I found low numbers of ants at the ungrazed sites at the farther distances away from the nests.

Ants were observed for 2 minutes every 15 minutes for a minimum of 8 observation periods per distance per nest. A total of 266 observation periods were done over the field season.

Ants that were within one meter on either side of the dish or were actually in the dish were counted as foraging at the dishes. In addition, dishes were placed at only one distance at a time to avoid distracting the ants to closer dishes and to allow the establishment and maintenance of a trunk trail to the dish.

The data were analyzed by using a two-way ANOVA for unequal sample numbers, with sampling periods within nests as the samples. This test was done to test the interaction between grazing treatment and foraging distance.

RESULTS AND DISCUSSION

A significantly ($P \leq 0.0001$) larger concentration of ants foraged at the longer distances for seeds on the grazed sites than on the ungrazed ones (Fig. 1). On both grazed and ungrazed sites, there was a high concentration of ant foragers at 6m. However, the number of foragers decreased sharply after 6m in the ungrazed sites while ants on the grazed sites regularly foraged at 18m and at all intermediate distances (Fig. 1). A significantly larger concentration of ants foraged at longer distances in the grazed sites than in the ungrazed sites ($P \leq 0.001$). The largest number of foraging ants in the grazed site was observed at

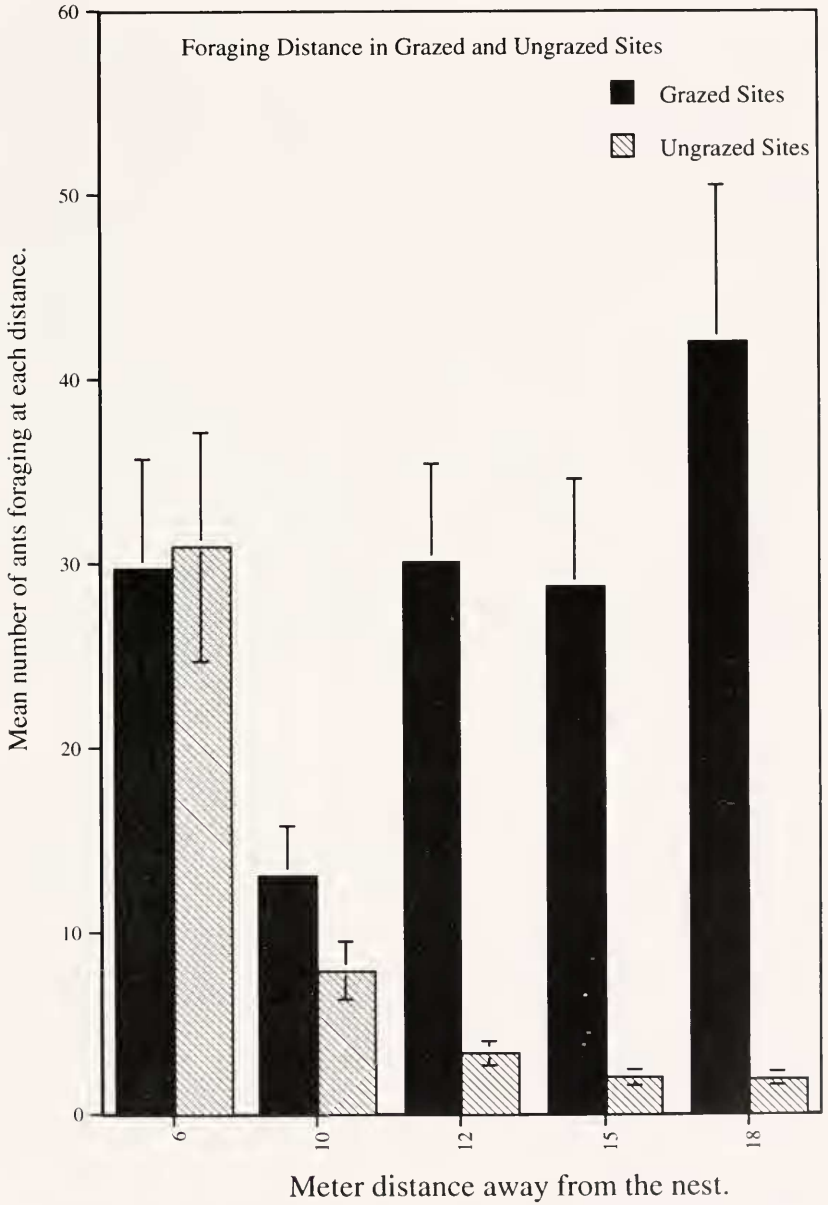

Fig. 1. Foraging distances of western harvester ants (*Pogonomyrmex occidentalis* Cresson) on grazed and ungrazed shortgrass rangeland (lines at the top of each bar indicate standard error of means).

18m (Fig. 1). In addition, when a two-way ANOVA was done on the interaction of ant numbers for each distance at grazed and ungrazed sites, the difference was highly significant ($P \leq 0.0001$).

The greater distances traveled on the grazed sites were likely caused by the increase in bare ground produced by livestock grazing (Milchunas et al. 1989, 1992; Gillen et al. 1991; Bock and Bock 1993), although the amount of bare ground and availability of the ants' preferred seeds were not examined in this study, I believe that this hypothesis is correct because Fewell (1988) showed that on sparsely vegetated sites, such as grazed sites, *P. occidentalis* walked significantly faster and farther without an increase in foraging time. In this study, the ants in the grazed sites foraged farther than those in the ungrazed sites to collect seeds, perhaps because there was more bare ground on the grazed sites, which lowered the likelihood that the ants would encounter a preferred seed in the shorter foraging ranges. However, in order to accurately determine if grazing treatments did affect the ants and their foraging distances, an accurate estimate of the number of ants or nests per hectare needs to be done.

Several other studies examined the foraging distance of *P. occidentalis* but those distances were not as long as those in this study. Crist and MacMahon (1992) found that foraging activity was concentrated 2-7m from the nest but could progress up to 7-12m. Rogers (1974) found that the maximum foraging distances of *P. occidentalis* were 14.3m in lightly grazed grasslands and 11.0m in heavily grazed grasslands. Rogers' findings are similar to mine because I found that the ants on the grazed sites commonly foraged farther, up to and beyond 18m away from the nest, whereas, in the ungrazed sites the ants foraged primarily at 6m.

Crist and MacMahon (1991) found that individual ants exhibited fidelity in their search sites, as well as a fidelity to certain seeds of certain select species. Their findings suggested that individual ants may forage in the same direction each day. In my study, individual ants could be actively foraging in the direction of previous dishes. However, the ants' fidelity is unlikely to artificially increase the foraging distance encountered in my study because my tests were not done on consecutive days.

The exact reason for the ants' extended foraging distances in the grazed sites remains unclear because there was a greater concentration of the ants' preferred seed species within 10m of the ant nests in the grazed sites. The first two preferred seed species of these ants were *Heterotheca villosa* (Asteraceae) and *Stipa comata* (Gramineae) (Usnick, 1996). Although the ants' preferred seed species are more abundant in the grazed than in the ungrazed sites, there was also a higher abundance of exotic, annual plants, which the ants do not prefer (Usnick, 1996).

Harvester ants do appear to have a preferred foraging habitat, which in this study is grazed grasslands. However, how these preferences are affected by habitat characteristics, such as increased bare ground and increased amounts

of exotic plants caused by grazing, remains unknown due to the difficulty in eliminating abiotic and biotic factors from the environment.

In addition, due to these environmental factors, colony growth over the year may be fairly flexible. The amount of seeds that the ants are capable of collecting would be less that the colony needs. This is especially apparent during the summer months when colony growth is at its highest point. Therefore, the ants may travel farther during the summer months than they would during other times of the year when they do not have the additional colony growth. These extended foraging distances would be especially apparent on grazed grasslands. Although grazed grasslands have higher numbers of the ants' preferred plant species (Usnick, 1996), they also have increased amounts of bare ground and more exotic plant species. Therefore the ants may have to forage farther and spend larger amounts of time to collect preferred seeds.

In conclusion, western harvester ants forage up to and beyond 18m in grazed shortgrass prairies, while most ants on ungrazed prairies foraged primarily at 6m. I suggest that grazed grasslands have larger amounts of bare ground and therefore, the ants must travel farther in grazed sites to find their preferred seeds.

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